

IN THE CLAIMS:

The text of all pending claims, (including withdrawn claims) is set forth below. Cancelled and not entered claims are indicated with claim number and status only. The claims as listed below show added text with underlining and deleted text with ~~striketrough~~. The status of each claim is indicated with one of (original), (currently amended), (cancelled), (withdrawn), (new), (previously presented), or (not entered).

1. (previously presented) A device comprising:
an optical circulator having first, second, and third ports, said first port being supplied with signal light including first and second polarization components respectively having first and second polarization planes orthogonal to each other, and with pump light;
a polarization beam splitter having fourth, fifth, and sixth ports, said fourth port being optically connected to said second port, said fourth and fifth
ports being coupled by said first polarization plane, said fourth and sixth ports being coupled by said second polarization plane; and
a polarization maintaining fiber having first and second ends, and having a polarization mode to be maintained between said first and second ends, said first end being optically connected to said fifth port so that said first polarization plane is adapted to said polarization mode, said second end being optically connected to said sixth port so that said second polarization plane is adapted to said polarization mode.
2. (previously presented) A device according to claim 1, wherein said polarization maintaining fiber has a substantially constant zero-dispersion wavelength in relation to said polarization mode, and said pump light has a wavelength
substantially equal to said zero-dispersion wavelength.
3. (previously presented) A device according to claim 1, wherein said signal light is converted into converted signal light by four-wave mixing based on said signal light and said pump light in said polarization maintaining fiber, said converted signal light being output from said third port of said optical circulator.
4. (previously presented) A device according to claim 3, wherein said converted signal light is a phase conjugate of said signal light.

5. (previously presented) A device according to claim 3, wherein:
said pump light has a third polarization plane; said third polarization plane being set so that the efficiency of conversion from said signal light to said converted signal light is independent of the polarization state of said signal light.
6. (previously presented) A device according to claim 3, wherein said signal light, said pump light, and said converted signal light have angular frequencies ω_s , ω_p , and ω_c , respectively,
said angular frequencies ω_s , ω_p , and ω_c substantially satisfying the relation of $2\omega_p = \omega_s + \omega_c$.
7. (previously presented) A device according to claim 3, further comprising an optical band-pass filter optically connected to said third port of said optical circulator and having a passband including the wavelength of said converted signal light.
8. (previously presented) A device according to claim 1, wherein said polarization maintaining fiber has first and second principle axes orthogonal to each other, and said polarization mode corresponds to one of said first and second principal axes.
9. (previously presented) A device according to claim 1, further comprising: a pumping source for outputting said pump light; and
an optical coupler optically connected to said first port of said optical circulator for combining said signal light and said pump light.
10. (previously presented) A device according to claim 1, further comprising means for modulating or dithering the frequency or phase of said pump light.
11. (currently amended) A device comprising:
a polarization beam splitter having first, second, and third ports, said first port being supplied with signal light including first and second polarization components respectively having first and second polarization planes orthogonal to each other, and with pump light, said first and second ports being coupled by said first polarization plane, said first and third ports being coupled by said second polarization plane; and

a polarization maintaining fiber having first and second ends, and having a polarization mode to be maintained between said first and second ends, said first end being optically connected to said second port so that said first polarization plane is adapted to said polarization mode, said second end being optically connected to said third port so that said second polarization plane is adapted to said polarization mode;

wherein said polarization mode to be maintained by said polarization maintaining fiber is given by a predetermined principal axis;

said first polarization plane of said signal light in said second port includes said predetermined principal axis; and

said second polarization plane of said signal light in said third port includes said predetermined principal axis.

12. (currently amended) A device, ~~according to claim 11, further comprising~~ comprising:

a polarization beam splitter having first, second, and third ports, said first port being supplied with signal light including first and second polarization components respectively having first and second polarization planes orthogonal to each other, with pump light, said first and second ports being coupled by said first polarization plan, said first and third ports being coupled by said second polarization plane;

a polarization maintaining fiber having first and second ends, and having a polarization mode to be maintained between said first and second ends, said first end being optically connected to said second port so that said first polarization plane is adapted to said polarization mode, said second end being optically connected to said third port so that said second polarization plane is adapted to said polarization mode; and

an optical circulator optically connected to said first port of said polarization beam splitter.

13. (currently amended) A device, ~~according to claim 11, comprising:~~

a polarization beam splitter having first, second, and third ports, said first port being supplied with signal light including first and second polarization components respectively having first and second polarization planes orthogonal to each other, with pump light, said first and second ports being coupled by said first polarization plan, said first and third ports being coupled by said second polarization plane; and

a polarization maintaining fiber having first and second ends, and having a polarization mode to be maintained between said first and second ends, said first end being optically

connected to said second port so that said first polarization plane is adapted to said polarization mode, said second end being optically connected to said third port so that said second polarization plane is adapted to said polarization mode; and

wherein said polarization maintaining fiber has a substantially constant zero-dispersion wavelength in relation to said polarization mode, and said pump light has a wavelength substantially equal to said zero-dispersion wavelength.

14. (previously presented) A system comprising:

first and second optical fiber networks each adapted to wavelength division multiplexing;
and

a converter connected between said first and second optical fiber networks, said converter converting signal light into converted signal light by nonlinear optical effect based on said signal light and pump light, wherein said converter comprises:

a pumping source for outputting pump light;

an optical circulator having first, second, and third ports, said first port being supplied with signal light including first and second polarization components respectively having first and second polarization planes orthogonal to each other, and with said pump light;

a polarization beam splitter having fourth, fifth, and sixth ports, said fourth port being optically connected to said second port, said fourth and fifth ports being coupled by said first polarization plane, said fourth and sixth ports being coupled by said second polarization plane;
and

a polarization maintaining fiber having first and second ends, and having a polarization mode to be maintained between said first and second ends, said first end being optically connected to said fifth port so that said first polarization plane is adapted to said polarization mode, said second end being optically connected to said sixth port so that said second polarization plane is adapted to said polarization mode.

15. (previously presented) A system according to claim 14, wherein said signal light is converted into said converted signal light by a second-order or third order nonlinear optical effect.

16. (previously presented) A system according to claim 14, wherein said signal light is converted into said converted signal light by four-wave mixing based on said signal light and said pump light

17. (previously presented) A system according to claim 14, wherein said converted signal light is a phase conjugate of said signal light.

18. (previously presented) A system according to claim 14, wherein said signal light is WDM signal light obtained by wavelength division multiplexing a plurality of optical signals having different wavelengths.

19. (previously presented) A system according to claim 18, wherein the wavelengths of said plurality of optical signals are arranged at unequal intervals.

20. (canceled)

21. (previously presented) A system according to claim 14, wherein:
said first optical fiber network includes a first fiber span for transmitting said signal light;
and
said second optical fiber network includes a second fiber span for transmitting said converted signal light.

22. (previously presented) A system according to claim 21, wherein when each of said first and second fiber spans is virtually divided into the same number of sections, the product of the average of chromatic dispersions of a first one of said sections of said first fiber span and the length of said first one is substantially equal to the product of the average of chromatic dispersions of a second one of said sections of said second fiber span and the length of said

second one, said first and second ones corresponding to each other in order as counted from said converter, and the product of the average of optical powers in said first one, the average of nonlinear coefficients in said first one, and the length of said first one is substantially equal to the product of the average of optical powers in said second one, the average of nonlinear coefficients in said second one, and the length of said second one.

23. (previously presented) A system according to claim 21, wherein:
the ratio of the product of an optical power and a nonlinear coefficient to a chromatic dispersion at a first point on said first fiber span is substantially

equal to the ratio of the product of an optical power and a nonlinear coefficient to a chromatic dispersion at a second point on said second fiber span;

an accumulated value of chromatic dispersions measured from said converter to said first point being equal to an accumulated value of chromatic dispersions measured from said converter to said second point.

24. (previously presented) A system according to claim 21, wherein:

the ratio of the product of an optical power and a nonlinear coefficient to a chromatic dispersion at a first point on said first fiber span is substantially

equal to the ratio of the product of an optical power and

a nonlinear coefficient to a chromatic dispersion at a second point on said second fiber span;

an accumulated value of the products of optical powers and nonlinear coefficients measured from said converter to said first point being equal to an accumulated value of the products of optical powers and nonlinear coefficients measured from said converter to said second point.

25. (previously presented) A system according to claim 21, wherein the product of the average of chromatic dispersions of said first fiber span and the length of said first fiber span is substantially equal to the product of the average of chromatic dispersions of said second fiber span and the length of said second fiber span.

26. (previously presented) A system according to claim 21, wherein the product of the average of optical powers in said first fiber span, the average of nonlinear coefficients in said first fiber span, and the length of said first fiber span is substantially equal to the product of the average of optical powers in said second fiber span, the average of nonlinear coefficients in said second fiber span, and the length of said second fiber span.

27. (Withdrawn) A device comprising:

a first optical circulator having first, second, and third ports, said first port being supplied with

first signal light including first and second polarization components respectively having first and second polarization planes orthogonal to each other, and with first pump light;

a second optical circulator having fourth, fifth, and sixth ports, said fourth port being

supplied with second signal light including third and fourth polarization components respectively having third and fourth polarization planes orthogonal to each other, and with second pump light;

a polarization beam splitter having seventh, eighth, ninth, and tenth ports, said seventh port being optically connected to said second port, said tenth port being optically connected to said fifth port, said seventh and eighth ports being coupled by said first polarization plane, said seventh and ninth ports being coupled by said second polarization plane, said ninth and tenth ports being coupled by said third polarization plane, said eighth and tenth ports being coupled by said fourth polarization plane; and

a polarization maintaining fiber having first and second ends, and having first and second polarization modes to be maintained between said first and second ends, said first end being optically connected to said seventh port so that said first and fourth polarization planes

are respectively adapted to said first and second polarization modes, said second end being optically connected to said eighth port so that said second and third polarization planes are respectively adapted to said first and second polarization modes.

28. (Withdrawn) A device according to claim 27, wherein said polarization maintaining fiber has a substantially constant zero-dispersion wavelength in relation to each of said first and second polarization modes, and each of said first and second pump lights has a wavelength substantially equal to said zero-dispersion wavelength.

29. (Withdrawn) A device according to claim 27, wherein:
said first signal light is converted into first converted signal light by four-wave mixing based on said first signal light and said first pump light in said polarization maintaining fiber, said first converted signal light being output from said third port of said first optical circulator; and
said second signal light is converted into second converted signal light by four-wave mixing based on said second signal light and said second pump light in said polarization maintaining fiber, said second converted signal light being output from said sixth port of said second optical circulator.

30. (Withdrawn) A device according to claim 29, wherein said first and second converted signal lights are phase conjugates of said first and second signal lights, respectively. 31. A system comprising:
first and second optical fiber networks each adapted to wavelength division multiplexing;
and

a converter connected between said first and second optical fiber networks;

said converter comprising:

first and second pumping sources for outputting first and second pump lights,

respectively;

a first optical circulator having first, second, and third ports, said first port being supplied with first signal light including first and second polarization components respectively having first and second polarization planes orthogonal to each other, and with said first pump light;

a second optical circulator having fourth, fifth, and sixth ports, said fourth port being supplied with second signal light including third and fourth polarization components respectively having third and fourth polarization planes orthogonal to each other, and with said second pump light;

a polarization beam splitter having seventh, eighth, ninth, and tenth ports, said seventh port being optically connected to said second port, said tenth port being

optically connected to said fifth port, said seventh and eighth ports being coupled by said first polarization plane, said seventh and ninth ports being coupled by said second polarization plane, said ninth and tenth ports being coupled by said third polarization plane, said eighth and tenth ports being coupled by said fourth polarization plane; and

a polarization maintaining fiber having first and second ends, and having first and second polarization modes to be maintained between said first and second ends, said first end being optically connected to said seventh port so that said first and fourth polarization planes are respectively adapted to said first and second polarization modes, said second end being optically connected to said eighth port so that said second and third polarization planes are respectively adapted to said first and second polarization modes.

31. (Withdrawn) A system comprising:

first and second optical fiber networks each adapted to wavelength division multiplexing;

and

a converter connected between said first and second optical fiber networks;

said converter comprising:

first and second pumping sources for outputting first and second pump lights,

respectively;

a first optical circulator having first, second, and third ports, said first port being supplied with first signal light including first and second polarization components respectively having first and second polarization planes orthogonal to each other, and with said first pump light;

a second optical circulator having fourth, fifth, and sixth ports, said fourth port being supplied with second signal light including third and fourth polarization components respectively having third and fourth polarization planes orthogonal to each other, and with said second pump light;

a polarization beam splitter having seventh, eighth, ninth, and tenth ports, said seventh port being optically connected to said second port, said tenth port being

optically connected to said fifth port, said seventh and eighth ports being coupled by said first polarization plane, said seventh and ninth ports being coupled by said second polarization plane, said ninth and tenth ports being coupled by said third polarization plane, said eighth and tenth ports being coupled by said fourth polarization plane; and

a polarization maintaining fiber having first and second ends, and having first and second polarization modes to be maintained between said first and second ends, said first end being optically connected to said seventh port so that said first and fourth polarization planes are respectively adapted to said first and second polarization modes, said second end being optically connected to said eighth port so that said second and third polarization planes are respectively adapted to said first and second polarization modes.

32. (Withdrawn) A system according to claim 31, wherein:

said first signal light is converted into first converted signal light by four-wave mixing based on said first signal light and said first pump light in said polarization maintaining fiber, said first converted signal light being output from said third port of said first optical circulator; and

said second signal light is converted into second

converted signal light by four-wave mixing based on said second signal light and said second pump light in said polarization maintaining fiber, said second converted signal light being output from said sixth port of said second optical circulator.

33. (Withdrawn) A system according to claim 31, wherein said first and second converted signal lights are phase conjugates of said first and second signal lights, respectively.

34. (currently amended) A device comprising:

a polarization beam splitter having first, second, and third ports, said first and second ports being coupled by a first polarization plane, said first and third ports being coupled by a second polarization plane orthogonal to said first polarization plane; and

a polarization maintaining fiber having first and second ends, the first end connected to the second port and the second end connected to the third port, and having a polarization mode to be maintained between said first and second ends, said polarization maintaining fiber being supplied with signal light including first and second polarization components respectively having said first and second polarization planes, and with pump light;

said signal light being converted into converted signal light by nonlinear optical effect based on said signal light and pump light in said polarization maintaining fiber;

wherein said polarization mode to be maintained by said polarization maintaining fiber is given by a predetermined principal axis;

said first polarization plane of said signal light in said second port includes said predetermined principal axis; and

said second polarization plane of said signal light in said third port includes said predetermined principal axis.

35. (previously presented) A system comprising:

first and second optical fiber networks each adapted to wavelength division multiplexing;
and

a converter connected between said first and second optical fiber networks, said converter converting signal light into converted signal light by nonlinear optical effect based on said signal light and pump light, wherein said signal light is WDM signal light obtained by wavelength division multiplexing a plurality of optical signals having different wavelengths and arranged at unequal intervals.

36. (currently amended) A system comprising:

first and second optical fiber networks each adapted to wavelength division multiplexing
wherein:

said first optical fiber network includes a first fiber span for transmitting said signal light;
and

said second optical fiber network includes a second fiber span for transmitting said converted signal light; and

a converter connected between said first and second optical fiber networks, said converter converting signal light into said converted signal light by nonlinear optical effect based on said signal light and pump light;

wherein when each of said first and second fiber spans is virtually divided into the same

number of a plurality of sections, the product of the average of chromatic dispersions of a first one of said plurality of said sections of said first fiber span and the length of said first one is substantially equal to the product of the average of chromatic dispersions of a second one of said plurality of said sections of said second fiber span and the length of said second one, said first and second ones corresponding to each other in order as counted according to distance from said converter, and the product of the average of optical powers in said first one, the average of nonlinear coefficients in said first one, and the length of said first one is substantially equal to the product of the average of optical powers in said second one, the average of nonlinear coefficients in said second one, and the length of said second one.

37. (currently amended) A system comprising:

first and second optical fiber networks each adapted to wavelength division multiplexing wherein:

said first optical fiber network includes a first fiber span for transmitting said signal light; and

said second optical fiber network includes a second fiber span for transmitting said converted signal light; and

a converter connected between said first and second optical fiber networks, said converter converting signal light into converted signal light by nonlinear optical effect based on said signal light and pump light;

wherein:

when each of said first and second fiber spans is virtually divided into the same number of a plurality of sections, the ratio of the product of an average of an optical power and a nonlinear coefficient to a chromatic dispersion at a first ~~point on said one of said plurality of said sections of said~~ first fiber span is substantially equal to the ratio of the product of an average of the optical power and an average of a nonlinear coefficient to a chromatic dispersion ~~at a second point on said~~ in a second one of said plurality of said sections of said second fiber span; and

an accumulated value of chromatic dispersions measured from said converter to said to a first point on said first one being equal to an accumulated value of chromatic dispersions measured from said converter to a said second point on said second one; and

said first and second ones corresponding to each other in order as counted according to distance from said converter.

38. (currently amended) A system comprising:

first and second optical fiber networks each adapted to wavelength division multiplexing wherein:

said first optical fiber network includes a first fiber span for transmitting said signal light; and

said second optical fiber network includes a second fiber span for transmitting said converted signal light; and

a converter connected between said first and second optical fiber networks, said converter converting signal light into converted signal light by nonlinear optical effect based on said signal light and pump light;

wherein:

when each of said first and second fiber spans is virtually divided into the same number of a plurality of sections, the ratio of the product of an optical power and a nonlinear coefficient to a chromatic dispersion at a first point on a first one of said plurality of said sections of said first fiber span is substantially equal to the ratio of the product of an optical power and a nonlinear coefficient to a chromatic dispersion at a second point on a second one of said plurality of said sections of said second fiber span; and

an accumulated value of the products of optical powers and nonlinear coefficients measured from said converter to said first point being equal to an accumulated value of the products of optical powers and nonlinear coefficients measured from said converter to said second point on said second one; and

said first and second ones corresponding to each other in order as counted according to distance from said converter.

39. (currently amended) A system comprising:

first and second optical fiber networks each adapted to wavelength division multiplexing wherein:

said first optical fiber network includes a first fiber span for transmitting said signal light; and

said second optical fiber network includes a second fiber span for transmitting said converted signal light; and

a converter connected between said first and second optical fiber networks, said converter converting signal light into converted signal light by nonlinear optical effect based on said signal light and pump light;

wherein when each of said first and second fiber spans is virtually divided into the same number of a plurality of sections, the product of the average of chromatic dispersions of said first fiber span and the length of said first fiber span is substantially equal to the product of the average of chromatic dispersions of said second fiber span and the length of said second fiber span a second one of said plurality of said sections of and the length of said second one; and
said first and second ones corresponding to each other in order as counted according to distance from said converter.

40. (currently amended) A system comprising:

first and second optical fiber networks each adapted to wavelength division multiplexing wherein:

said first optical fiber network includes a first fiber span for transmitting said signal light; and

said second optical fiber network includes a second fiber span for transmitting said converted signal light; and

a converter connected between said first and second optical fiber networks, said converter converting signal light into converted signal light by nonlinear optical effect based on said signal light and pump light;

wherein when each of said first and second fiber spans is virtually divided into the same number of a plurality of sections, the product of the average of optical powers in a first one of said plurality of said first fiber span, the average of nonlinear coefficients in said first fiber spanone, and the length of said first fiber spanone is substantially equal to the product of the average of optical powers in a second one of said plurality of said sections of said second fiber span, the average of nonlinear coefficients in said second fiber spanone, and the length of said second fiber spanone; and

said first and second ones corresponding to each other in order as counted according to distance from said converter.

41. (NEW) A device comprising:

a polarization beam splitter having first, second, and third ports, said first port being supplied with signal light including first and second polarization components respectively having first and second polarization planes orthogonal to each other, and with pump light, said first and second ports being coupled by said first polarization plane, said first and third ports being coupled by said second polarization plane; and

a polarization maintaining fiber having first and second ends, and having a polarization mode to be maintained between said first and second ends, said first end being optically connected to said second port so that said first polarization plane is adapted to said polarization mode, said second end being optically connected to said third port so that said second polarization plane is adapted to said polarization mode; and

wherein signal light having said first polarization plane inputted to said first port is outputted from said first and second end, the second light outputted from said second end is outputted from said first port through said polarization beam splitter, signal light having said second polarization plane inputted to said first port is outputted from said first end, and the signal light outputted from said first end is outputted from said first port through said polarization beam splitter.